

INVESTIGATION INTO METHODS
AND
COSTS FOR DISPOSAL OF
REMOVED UNDERGROUND PETROLEUM
STORAGE TANKS AND ASSOCIATED CONTENTS



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D.A. JOHNSTON & D.E. JARDINE
P.E.I. DEPT. OF THE ENVIRONMENT
P.O. BOX 2000, CHARLOTTETOWN
P.E.I. CIA 7N8

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**JUSTIFICATION & TERMS OF REFERENCE
FOR A JOINT STUDY BETWEEN
ENVIRONMENT CANADA & THE PROVINCE OF PRINCE EDWARD ISLAND
EXTENSION OF UNDERGROUND STORAGE TANK PILOT PROJECT
FISCAL YEAR 88-89**

INTRODUCTION:

During the implementation of the Prince Edward Island Petroleum Storage Tanks Regulations some additional projects were obviously needed to identify solutions to a number of problems. One of these problems has been the disposal of tanks removed from the subsurface. This has resulted in an accumulation of these tanks throughout the province as there is no currently practiced disposal method. A quick survey of provincial contacts across Canada has revealed that this is a common problem across the country. The province of Prince Edward Island is prepared to undertake a project in conjunction with Environment Canada on this problem. This would be considered an extension of the P.E.I. Pilot Project.

OBJECTIVES:

1. To identify existing methods and costs of tanks and sludge disposal across North America.
2. To compile a list of acceptable methods and costs of tank and sludge disposal.

TASKS:

The province will undertake the following:

1. Contact regulatory agencies across Canada and the United States to identify methods of tank and sludge disposal currently practiced.
2. Contact petroleum industry representatives across Canada and some in the United States as per no. 1.
3. Compile a list of tank installers across Canada and circulate a questionnaire to them to ascertain methods of disposal currently practiced by the industry.
4. Identify the acceptable methods for tank and sludge disposal giving the procedures and costs involved with each.
5. Prepare a final report giving the details on the findings of the project.

EXECUTIVE SUMMARY

Disposal options and costs are examined for removed steel underground petroleum tank systems and associated sludges in both Canada and the United States. Regulatory agencies in Canada and thirteen American States were contacted for information on disposal methods currently practiced and regulations specifically governing tank disposal. Information for this report was derived from 200 responses to questionnaires on all aspects of tank removals forwarded by mail to known installers and removers of underground petroleum storage tank systems in Canada.

The number of underground petroleum storage tank systems in need of disposal is being increased by such factors as: tank age liabilities and dangers associated with releases, more stringent regulatory requirements and increasing public awareness. Contractors are removing an increasing number of tanks which have been afflicted by one or more of these factors. Comments made by contractors in the questionnaire indicate a shortage of disposal options currently exist.

Underground Storage Tank Regulations from each province and state were examined and a pattern can be established in accordance with groundwater dependency. Areas most dependent on groundwater have a distinct tendency to favor more stringent regulations towards underground storage tank management and tank disposal. These jurisdictions tend to encounter the greatest number of removals and thus expressed major concerns for lack of disposal options.

Five areas were identified as having specific conditions for the approval of tank disposal facilities, these being: New Brunswick, Nova Scotia, Maine, Massachusetts and New York. Two facilities dealing solely with tank disposal were encountered, one in Chicopee, Massachusetts and another near Moncton, New Brunswick. Both facilities use high pressure steam to clean tank interiors and eventually tanks are sold for scrap steel.

The results of the installers questionnaire provided direct insight into current methods of disposal and the concerns of these contractors. Section "E" and "F" offered questionnaire participants an opportunity to express concerns in the area of tank removals and installations and also to identify areas where they feel more research is necessary. These areas are organized by province. All aspects of tank and sludge disposal took first place in nine provinces and many areas were identified as needing further research including: installations of fiberglass piping in cold weather, the internal deterioration of steel tanks, tank tightness testing procedures, the monitoring of cathodically protected tanks and secondary containment systems.

Disposal methods currently practiced by contractors for tanks and piping may be examined in Tables II and III. These Tables indicate that to cut up and sell for scrap is the most commonly practiced method, followed by punching holes in the tank and sending it to a disposal site. Table IV exhibits the methods currently used for sludge disposal. The most prominent being to hire a hazardous waste firm for disposal, followed by placement in sealed drums to store.

The purging and cleaning of underground petroleum storage tank systems is an necessary step in the disposal process. Vapors must be removed from the tanks, and contractors indicated the most popular method in use is to introduce dry ice and spread evenly over the tank bottom. Many contractors expressed concerns for the potential dangers involved in the handling of tanks which have contained Class I liquids. Several accidents and in certain cases, loss of life has resulted during tank removals. Two fatalities have been recorded in newspaper clippings (see Appendix B). Safety must be of the upmost concern during tank removals and this is reflected in regulations on the removal of tanks containing Class I liquids in the State of Maine, where detailed regulations specifically govern removal of these tanks. Proper conditioning of underground petroleum storage tank systems will tend to make tanks more acceptable to scrap yard dealers.

Options for disposal of tanks and piping are discussed in Section V under the following headings: as scrap (recycling), landfilling, refurbishing and reuse. Information on acceptance of tanks at scrap yards was collected from a questionnaire forwarded to scrap dealers (see Appendix C) and through phone conversations. Scrap dealers pay varying prices for scrap steel derived from these tanks and contractors should contact the dealer for specifications on acceptance of such materials. The Institute of Scrap Iron and Steel has offered guidelines to scrap dealers in this area and these are included in Appendix D.

As Table II indicates, landfilling is a popular disposal option for tanks. The availability of this option is dependent on provincial regulations controlling landfill sites and also on the space available versus the number of tanks needing disposal. Tanks that have not been properly cleaned could be potential threats to ground and surface water sources when placed in landfills.

Several refurbishing techniques are now available on todays market, including interior linings and exterior coatings. Underwriters Laboratory of Canada (ULC) and the American Petroleum Institute (API) have publications addressing this subject; although few contractors have indicated refurbishing as an disposal option.

Re-use of underground petroleum storage tanks is not a popular option, probably due to a limited demand. Our research found tanks are being used as culverts, cattle feeders and in sewage disposal systems. The acceptance of reuse as an environmental safe method needs further consideration.

The recommended method for disposal of tanks and piping is to clean tanks at a tank disposal facility and sell as scrap steel. Guidelines for the approval of such facilities are outlined in Section VII. To ensure proper disposal of tanks, regulatory agencies must take initiative to create guidelines or regulations on facilities and methods.

Disposal options for sludges are listed as enhanced landfarming, incineration and waste oil pits. Landtreatment is mainly utilized by refineries to treat sludges produced on site. Two approved facilities for the incineration of sludges are located in Quebec and Ontario. Waste oil pits and landfilling as presently practiced are not without environmental risks.

Due to the lack of disposal options presently available, most contractors have indicated they hire a hazardous waste firm. The recommended methods for sludge presently available are: hire a hazardous waste firm approved by the appropriate regulatory agency, land treatment and incineration. Research is necessary to identify sludge disposal options that could be accessible to contractors in all regions.

The cost to dispose of sludges by one hazardous waste firm may be seen in Table V. Table VI indicates cost derived from questionnaire results, these being the prices presently charged in each province to dispose of tanks and sludges.

To improve the overall situation of underground petroleum storage tanks across Canada, in regards to removals and installations, the licensing or registration of contractors is recommended.

I. THE DISPOSAL PROBLEM

A. Identifying the Problem

In recent years, numerous factors have brought about a need for acceptable disposal methods for large numbers of removed underground petroleum storage tanks piping and associated sludges. These systems are being removed from the subsurface at an increasing rate in both Canada and the United States. Contractors involved in the business have limited options available at present. Liabilities and dangers associated with the cleaning and recycling process have resulted in a reluctance of many firms to handle these vessels, particularly if they have held Class I liquids and especially leaded gasoline. During our research, only two facilities (one each in Canada and the United States) which deal strictly with tank cleaning and disposal were located.

In February of 1988, a study entitled "Underground Storage Tank Disposal Alternatives, Economics and Environmental Costs" was produced by the Water Resources Center in Blacksburg, Virginia. This report discusses the current tank disposal dilemma in the United States and lists disposal options and cost comparisons.

B. Why We Have The Problem

Factors which influence the number of tanks for disposal are listed and discussed below:

- i. Tank Age
- ii. Liabilities & Dangers
- iii. Regulatory Requirements
- iv. Public Awareness

i) Tank Age

The age of Underground Storage Tank (U.S.T.) Systems, play an important role in the decision to discontinue use and many tanks now in service have outlived their useful life span. Canada has an estimated tank population of 200,000, many which were installed in the 50's and 60's (Environmental Code of Practise for Underground Storage Tanks). In 1986, the United States Environmental Protection Act estimated the average non-leaking life span of underground storage tanks to be 15-17 years. In 1987, staff of P.E.I.'s Underground Petroleum Storage Tank Program inspected 132 tank removals and found 36 of these to be leaking and in 1988, 41 of the 382 removals inspected were found to be leaking. Other factors such as improper installation, soil resistivity, and damage during or after installation have caused tanks to leak much sooner. As tank age increases, so does the probability for leakage due to corrosion. A Tank Corrosion Study on 500 plain steel

tanks was undertaken by the Department of Health Services, Community of Suffolk, Long Island, New York. The tanks in this study ranged from 2 to 70 years old and varied from 175 gallons to 50,000 gallons. The study concluded that 143 of the removed tanks contained perforations, or one would expect to find approximately 30% of the tanks with perforations (Harris & Halpin, 1988). Bearing in mind statistics like these, many companies and individual tank owners have voluntarily initiated removal and replacement schedules.

ii. Liabilities

The liabilities associated with leaking underground storage tanks have prompted much replacement and upgrading in both private and commercial sectors. The cost of liability insurance continues to escalate and is becoming economically unattainable for individuals and smaller companies with aging tanks. Soil and groundwater clean up costs resulting from petroleum contamination have risen as advanced techniques are utilized and cleanups are required by regulatory agencies. Many tank owners now realize they are held fully responsible for all costs associated with cleanups. Incidents of petroleum vapors accumulating in buildings in close vicinity to spill sites, have created potentially dangerous situations. Contractors or individuals who dispose of tanks in an improper manner may be liable for any health and environmental damages resulting from this. Certainly the incidents in Appendix B of this report indicate the potential for possible legal action and excess financial implications.

iii. Regulatory Requirements

Current and pending regulations have set specific limits on replacement of aging underground storage tank systems. Many Canadian provinces and U.S. states have adopted their own underground storage tank regulations in conjunction with fire codes. Through tank registration programs, aging systems are identified and owners sent notification for replacement, upgrading, or removal. Regulations requiring daily inventory control have led to leaking tanks being identified and also require tanks out of service for a period of time to be removed. Regulations have and will continue to play a major role in the number of these tanks in need of disposal.

Abandonment or closure of tanks in place is still being approved in some regions, but is becoming less popular with regulatory agencies. Removal of the systems allow for examination of the tank for perforations and the surrounding soil for contamination, assuring the tank owner of no further problems. Tanks left in place and filled with inert materials (i.e. concrete or sand) may also pose hazards to future construction in the area.

iv. Public Awareness

Media attention has served as an instrument to create greater public awareness of environmental issues, particularly leaking underground storage tanks. Through media sources, the general public are made aware of the damage and personal inconveniences that result when contaminants are released into the soil and groundwater sources. Major companies may experience declining profits and public images due to adverse media coverage of leaking tanks.

C. Conclusion

When all factors are considered, it is evident that there now exists a disposal problem that will become larger as time progresses. At the time of this report, one contractor on P.E.I. has in excess of 200 underground storage tanks awaiting proper disposal. Few agencies have taken steps to outline disposal methods, and most advise: "Dispose of it in a manner acceptable to the regulatory agency". Contractors share a general opinion that regulatory agencies should offer a solution to a problem which they assisted in creating. Our report will examine the options available and make recommendations as to environmentally safe and economically feasible solutions.

II. REVIEW OF CURRENT REGULATIONS

A. General:

Regulatory agencies in the Provinces and Territories of Canada, and certain U.S. States were contacted for current regulations pertaining directly to tank disposal. Information on disposal techniques from Holland was sought without success. Regulations tend to vary widely and a pattern can be established in accordance with groundwater dependency. Provinces and States such as Maine, Massachusetts, New York (Long Island), New Brunswick and Prince Edward Island have a distinct tendency to lean towards more stringent regulations on underground storage tanks, sludges and disposal practices due to their high groundwater dependency.

Areas with alternate water supplies (i.e. surface water) have established less defined regulations in this field. In accordance with this pattern, more tank removals are taking place in areas most sensitive to groundwater contamination.

Even with the disposal problem being more evident in certain areas the general consensus of regulatory agencies is the need for a viable solution. Areas that do not have a present problem, expressed concerns for future needs. Our research has shown that to dispose of a steel underground petroleum storage tank, in any area, is no simple task.

Outlined below are the Provinces and U.S. States which have been contacted and a brief summary of their regulations.

B. Provincial Regulations:

(i) New Brunswick

New Brunswick's underground storage tank population is governed under the "Clean Environment Act - Petroleum Product Storage and Handling Regulation" which became effective on July 30, 1987. This Act covers all aspects of tank management and New Brunswick's Municipal Affairs & Environment Department also enforces a report entitled "Petroleum Storage Tank Decommissioning". The latter report addresses procedures for tank cleaning and removal.

Presently six sites in this province have been approved for tank disposal; five for "clean tanks", none of which are in operation at this time. The only site approved for unclean tanks has been operational for several years. This facility has the capability to clean tanks as well as remove the ends, making them acceptable to scrap dealers.

(ii) Prince Edward Island

Underground Storage Tanks Regulations made their debut in Prince Edward Island in September, 1986, making it the first Maritime Province to enact such regulations. Similar to New Brunswick's in scope, these also cover all aspects of tank management. Prince Edward Island's disposal problem is being accelerated by replacement scheduling instilled in the "Petroleum Storage Tanks Regulations". In light of this fact, P.E.I. has already had in excess of 500 removals since the regulations became effective.

Contractors on P.E.I. are presently storing tanks and sludges for future disposal and a few tanks have been sold for scrap. P.E.I. is in need of a disposal solution and this need will increase as replacement scheduling affects more tanks.

(iii) Nova Scotia

Similar to P.E.I. and N.B., Nova Scotia has adopted provincial regulations under "The Dangerous Goods and Hazardous Waste Management Act". This Act governs management of underground and certain above ground petroleum storage tank systems.

Nova Scotia's Environment Department has recently developed guidelines for the approval of tank disposal facilities. Contractors indicated tanks are being cut up and sold for scrap or taken to landfill sites. Sludges are being stored in 45 gallon drums and most go to a hazardous waste firm for disposal.

(iv) Newfoundland

Newfoundland's Department of Environment & Lands enforces the "Gasoline Handling Act" which includes underground petroleum storage tank management. Contractors in this province currently clean the tanks, cut holes in the ends and deliver to a provincially regulated landfill site where they are flattened and landfilled. Landfills can only accommodate a limited quantity of tanks in a certain time period and according to contractors there is a definite need for alternate disposal options. Scrap dealers here have not shown an interest in these tanks but the regulatory agency does allow removed tanks to be used in sewage disposal systems.

(v) Quebec

The Quebec Environment Department regulates underground storage tank systems under recently enacted "Petroleum Products Regulations". Section 1876 of this Act outlines disposal of an unreuseable tank, but Quebec does not have specific disposal sites for this purpose. Tanks are being accepted by some scrap metal dealers and sludges must be stored in a covered metal containers, and disposed of in compliance with the regulations under the Environment Quality Act.

(vi) Ontario

The Fuels Safety Branch in Ontario enforces the "Gasoline Handling Act and Code" which includes regulations on petroleum storage tanks. This Act requires tanks to be rendered unfit for future use and presently no guidelines for disposal sites are in effect. Contractors are delivering tanks to scrap metal dealers, and sludges are taken to government approved sites. The Fuels Safety Branch is not presently aware of a disposal problem but current regulations have replacement scheduling in place.

(vii) Manitoba

Manitoba is currently in the process of amending their 1974 "Storage of Gasoline and Associated Products" which governs their underground storage tank population. These amendments include an upgrading schedule for existing systems, and this could increase the number of removals in the future. Presently tanks are shredded or taken to landfills approved by the Environment Department and sludges may be burned or landfilled at approved landfill sites. Manitoba does not promote the reuse of underground storage tanks and have experienced problems in controlling this situation.

(viii) Saskatchewan

This province has recently drafted the "Hazardous Substance Regulations" to regulate underground storage tanks and these became effective on April 1, 1989. Municipalities enforce the National Fire Code and there are no specific disposal sites for either tanks or sludges. Saskatchewan should see an increase in the number of tank removals following the implementation of these regulations.

(ix) British Columbia

The office of the Fire Commissioner enforces the National Fire Code in respect to petroleum storage tanks. B.C. Environment suggest that the province is not encountering a problem with tank disposal and have no plans for provincial regulations at this time. The B.C. Petroleum Association feels there is a need for further regulations and have submitted guidelines on tank management to the Provincial Government. The B.C. government has not responded at the time of this report.

(x) Yukon

The Department of Community & Transport Services enforces the National Fire Code for underground storage tanks in the Yukon. The common procedure for disposal is to cut out ends and crush at a dump site. Sludge is taken to a waste oil pit and dumped, but concerns have recently been raised over this practice.

(xi) North West Territories

The Fire Marshal's office follows the National Fire Code when addressing petroleum storage tanks. The perma frost in this area makes conditions unacceptable for underground storage, making above ground storage common. Conveniently the number of removals have been few and disposal tends to be a difficult matter, since no scrap dealers operate in the area and landfills do not accept steel. Tanks being removed are usually left abandoned on the contractor's property.

(xii) Alberta

The Fire Prevention Branch in Alberta enforces the Fire Prevention Act, which includes petroleum storage tanks. Under this Act, where storage tanks are to be disposed of, sufficient openings shall be cut in the tanks to render them unfit for further use. There are no disposal sites for tanks in Alberta, but there are some government approved sites that accept sludges. Alberta's tank population has not been registered at this time. The Fire Prevention Branch is involved with removals only when contamination is a factor.

C. United States Regulations

(i) Maine

Underground Storage Tanks in this state have been regulated by the Department of Environment under state regulations since April, 1986. Maine has also set up requirements for underground storage tanks disposal facilities entitled "Policy on Underground Oil Storage Regulations, Guidelines for Underground Tank Disposal Facilities". Requirements for site approval are outlined under the headings of 1) Siting; 2) Design; and 3) Operation.

These regulations state "No person shall dispose of an underground tank by removal except at a disposal facility approved by the Department". Maine's replacement scheduling for unprotected steel tanks will certainly add to their present disposal problem. According to Maine Environment officials, most tanks go to scrap metal dealers after being gas freed (dealers charge per gallon to accept tanks) or they are being stored on private property.

Sludges which are considered hazardous are picked up by hazardous waste disposal firms. Officials feel that regulations could prompt private industry to operate state approved tank disposal sites.

(ii) Massachusetts

The State Fire Marshal's Department in Massachusetts governs underground storage tanks under its Board of Fire Prevention Regulations. In addition to this, regulations entitled "Provisions for approving underground steel storage tank dismantling yards" have been effective since September 12, 1985. These require removed tanks to be delivered to state approved sites for dismantling. At this time, eight sites have state approval, including Massachusetts Tank Disposal Ltd. in Chicopee, Massachusetts that deals entirely with cleaning and cutting steel tanks. Sludges and contaminated waste waters must be treated as hazardous wastes and be removed by a hazardous waste firm or waste oil transporter.

(iii) Suffolk Co., Long Island, New York

This New York County has had underground storage regulations in affect since 1980 and officials here work very closely with contractors involved in tank removals and installations. All tanks may be disposed of in a manner approved by the regulatory agency. The tanks, after cleaning, are not considered hazardous, and most go to a shredder at Gershaw, Long Island. Contractors are required to drum sludges and deliver to state licensed hazardous waste sites.

(iv) Vermont

Vermont Water Resources enforces state underground storage tank regulations which became effective March, 1987. These regulations require underground storage tanks that are to be disposed of as junk to be retested for vapors, rendered vapor free, if necessary, and punched with holes to make it unfit for storage of liquids. Sludges are stored in drums and transported out of state for disposal. Officials here can foresee a disposal problem in the future and the problem has been discussed to some extent. Vermont has had approximately 1,000 tanks removed in the last three years.

(v) Virginia

Underground storage tanks are administered through the Water Control Board and this state has in excess of 60,000 underground storage tanks. Most removed tanks are sold for scrap, used for culverts or left lying above ground. Regulations have not approached the problem of tank disposal at this time.

(vi) Delaware

This state has a tank population in the vicinity of 6,000 and state regulations require tanks to be properly disposed. Contractors have two options for cleaned tanks: leave as it above ground or sell for scrap. Landfill sites will only accept sludges if they are considered nonhazardous. Officials here have expressed concerns for proper disposal methods.

(vii) Maryland

The Department of Environment in Maryland has 12 inspectors who administer state underground storage tank regulations. On the average these inspectors attend two removals each per day and may deal with 25-50 leaking tanks at any one time. Regulations do not address the disposal problem as such, but contractors do have the following options:

1. clean and use as culverts;
2. clean and deliver to salvage dealers;
3. farm use for grain or water storage (after cleaning);
4. salvage yards store tanks for up to 6 months and when they are vapour freed, are cut up.

Hazardous wastes are transported out of state for disposal. The use of tanks by farmers and as culverts has helped to keep Maryland's disposal problem to a minimum.

(viii) Florida

The Department of Environment in Florida administers state regulations for approximately 95,000 underground storage tanks. Disposal has not been addressed in their regulations, but some landfill sites and scrap yards will accept clean tanks. Tank bottoms are considered hazardous and the Department of Environment provides contractors with a disposal permit. Tanks are also used for farm purposes and while there have been inquiries concerning disposal several years ago, contractors seem to have found their own solutions.

(ix) California

According to the California State Water Board, there are some 160,000 underground storage tanks which have been regulated by state regulations since 1985.

Regulations throughout California are not uniform, since the counties and municipalities are charged with enforcement. Officials at different levels (i.e. state, county, municipal) have various methods of classifying tanks, wash water and sludges. Presently state regulations allow tanks to be abandoned in place but municipalities or counties may not

allow this practice. Most scrap yards will accept tanks which have been rendered gas free and the Health Services Department have licensed five facilities to accept tanks and sludges.

D. Specific Disposal Regulations

In the course of this project, thirteen U.S. States and all Provinces and Territories in Canada have been contacted for information on tank disposal. Many of these areas have enacted underground storage tank regulations unique to their geology, groundwater and specific needs while others enforce regulations based on Fire Codes. Of the States and Provinces contacted, five have specific conditions for approval of tank disposal facilities. These are listed below:

(i) Nova Scotia

Nova Scotia's Department of the Environment has recently developed regulations entitled "Disposal of Petroleum Storage Tanks". This regulation lists the criteria for such sites under fourteen headings. Several contractors have expressed interest in setting up a suitable facility for disposing of underground petroleum storage tanks and one certified contractor has been given consent to operate such a site.

(ii) New Brunswick

New Brunswick's Department of Municipal Affairs & Environment under the Petroleum Management Section have guidelines entitled "Petroleum Storage Tank Decommissioning Process". These guidelines address tank disposal under the following headings:

- a) Prior to Decommissioning
- b) Removal Procedure
- c) Storage Prior to Disposal
- d) Disposal of Tanks
- e) Abandonment in Plant
- f) Sludge and Oil Water Disposal

Under these guidelines once a tank has been properly removed from the site, the only acceptable location of disposal is at a site approved by the Minister, and the only acceptable means of disposal is for the tank to be cut up and sold for scrap. Disposal site operators will verify that tanks are free of petroleum product and vapors and shall issue a receipt for the tank. The only acceptable method for sludge disposal is recycling. The company and its methods shall be approved by the Minister.

The only operational provincially approved site in New Brunswick is located on three acres of land near Moncton. The facility deals solely with the cleaning of tanks and preparation for sale as scrap. Steam is used to clean the tanks and once they have been determined to be vapor free, the ends are removed and the tanks are transported to a scrap yard.

(iii) **Maine**

Maine's Environmental Protection Department has established guidelines for approval of Disposal Facilities. These guidelines set out in detail standards for state approval under the following areas:

- a) Applicability.
- b) Provisions for Obtaining Departmental Approval.
- c) Definitions.
- d) Siting.
- e) Design, and
- f) Operation

At the time of this project, no approved sites were in operation.

(iv) **Massachusetts**

Massachusetts office of the State Fire Marshal have regulations entitled "Provisions for Approving Underground Steel Storage Tank Dismantling Yards". Under Section 3:03 "Application for Tank Yard" fifteen conditions are listed and these must be met for approval.

Presently there are eight state approved sites in operation and one in Chicopee deals only with tanks. This privately operated disposal yard accepts tanks with a minimum amount of sludge. They are set on a concrete pad and cleaned with high pressure steam. Sludges are drummed and taken to a waste disposal site. Following the cleaning procedure, tanks are checked with an explosive meter and if vapor free are cut and sold as scrap steel. Each tank that arrives on site has a transit slip issued by the local Fire Marshal. A receipt is then issued and a copy returned to the Fire Marshal's office. This procedure ensures that removed tanks are taken to state approved sites. As of December, this facility had accepted over 1,000 tanks for disposal in 1988.

(v) **New York State**

The Department of Environmental Conservation in New York has issued guidelines entitled "Permanent Closure of Petroleum Storage Tanks" in January of 1987. These guidelines resulted from numerous inquiries requesting information on tank removal and

closure. Bulk Storage Regulations have resulted in a large number of tank removals in this state and these guidelines are a step by step procedure for permanent closure. The problem is addressed under the following headings:

- a) Procedure for Removal of Underground Tanks;
- b) Tank Abandonment in Place;
- c) Classification of Wastes Resulting from Permanent closure of Underground Storage Tanks;
- d) Waste Water Transportation Requirements;
- e) Waste Disposal Options.

Under Section 7.0, Waste Disposal Options, the final disposition of the removed tank shall be at a scrap yard or landfill site permitted by the state to accept these.

E. Summary

By initiating specific disposal and removal procedures, these agencies have shown there exists a need for Environmental Departments to provide guidance in this area. As the number of tank removals increase, so should inquiries on the subject and agencies will need to become more aware of the problem.

III. RESULTS OF THE TANK INSTALLERS QUESTIONNAIRE

A. General Application & Provincial Results

The basis of the information in this report originates from questionnaires completed by contractors across Canada.

At the beginning of the project, installers lists were requested from regulatory agencies across Canada. The response was excellent. Some 950 contractors were identified as being installers or removers of underground petroleum storage tanks. A five page questionnaire complete with covering letter, on all aspects of tank removal was forwarded to each name on the list. In the North West Territories and the Yukon, the questionnaire was distributed by the appropriate regulatory agency. The completed questionnaires were organized by province and the response from each can be found in Table I. The response realized from all of Canada was 20%. Many comments were included in these responses and these are identified and grouped by province. A copy of the questionnaire can be found in Appendix "A".

B. Registration of Installers

During the quest for installers, five provinces were identified as requiring contractors to be licensed or registered with regulatory agencies in order to work on underground petroleum storage tank systems. These Provinces are New Brunswick, Prince Edward Island, Nova Scotia, Quebec and Ontario. Outlined below are their requirements for licensing or registration.

(i) New Brunswick

A person may apply for an installer's license by completing and delivering to the Minister an application on a form provided by the Minister. The applicant must successfully complete a training program designed by the Minister and be in receipt of general liability insurance in an amount of at least one million dollars. The Minister may cancel or suspend the license if all work done by or under supervision of the holder does not conform to the "Clean Environment Act". Installers training courses are made available through provincial agencies in N.B.

(ii) Quebec

Quebec's newly enacted regulations require contractors to apply for an installer's permit which is issued under several different classes. Installers must submit an insurance certificate attesting that public liability insurance covers the site and operations.

TABLE 1

PROVINCIAL QUESTIONNAIRE RESULTS

PROVINCE OR TERRITORY	NUMBER OF QUESTIONNAIRES	REPLIES RECEIVED	INCOMPLETE ADDRESSES
NEW BRUNSWICK	87	16	--
PRINCE EDWARD ISLAND	51	17	2
NOVA SCOTIA	131	31	1
NEWFOUNDLAND	99	9	--
QUEBEC	88	15	7
ONTARIO	392	71	21
MANITOBA	18	6	--
SASKATCHEWAN	5	4	1
ALBERTA	32	10	1
BRITISH COLUMBIA	12	10	--
YUKON	--	--	--
NORTHWEST TERRITORIES	--	--	--
	915	189	33

(iii) **Prince Edward Island**

The Prince Edward Island "Petroleum Storage Tanks Regulations" state in Section 11(5) "only those individuals or contractors registered with the regulatory agency may install underground petroleum storage tanks". Contractors are required to successfully complete an exam prior to registration. Training courses sponsored by the Department of the Environment are offered for installers. This province is currently in the process of revising their regulations.

(iv) **Nova Scotia**

The Dangerous Goods & Hazardous Waste Management Act, Section 19(1) states: "No person or contractor who has not provided the Minister with information indicating his training and experience and who has not demonstrated a knowledge of these regulations in a manner and at a level of proficiency satisfactory to the Minister may install storage tank systems".

Installers are required to take an exam and there are two different licenses:

- Class I - gasoline and heating fuel
- Class II - heating fuel

Contractors installing fiberglass pipeline must obtain training in proper installation methods from a fiberglass pipeline supplier.

(v) **Ontario**

Potential applicants are interviewed by the "Fuels Safety Branch" prior to licensing by this department. Applicants are licensed on the basis of their experience and qualifications.

C. Installers Concerns and Areas Identified As Requiring Further Research

Sections E and F of the Questionnaire asked installers to list their concerns and areas where they felt research is necessary. These sections proved to be the most informative in the questionnaire. The concerns were reviewed and organized by Province and then grouped into five categories: 1) Tank Disposal; 2) Registration of Installers; 3) General Regulations; 4) Installers Training; 5) Areas where research is necessary.

Installers concerns in all aspects of tank and sludge disposal was of primary importance in nine provinces. Areas where research is necessary was second. Listed below by province, are the concerns installers noted.

(i) Nova Scotia

Installers were most concerned with the lack of disposal sites for tanks, sludges and associated piping and some feel government input is necessary to initiate such sites. One installer's comments reflect this concern: "The number of tank installers and removers that refuse to disposal of tanks properly and without government intervention, are effectively avoiding the substantial costs of tank and liquid disposal. This fact makes those contractors more economical and thus more profitable due to improper procedure". Other comments included a need for more detailed regulations in the areas of removal, degassing, cutting and disposal of steel tanks. A need for further training for installers and inspectors was mentioned in these comments. Identified as areas needing further research were installation of fiberglass piping and secondary containment systems.

(ii) New Brunswick

Installers in New Brunswick seem to have more problems disposing of sludges and contaminated soil than the tanks. This could be attributed to the fact that a site is in operation for "unclean" tanks, but several comments on a lack of sites were included. In the opinion of one registered installer there are too many installers presently registered and he feels installers should also be licensed for pipe fitting.

The only area identified as needing research was secondary containment systems.

(iii) Prince Edward Island

The most evident concern of P.E.I. installers was the need for proper disposal sites of tanks, piping and sludges. Two registered installers expressed interest in operating such a site. Possible internal deterioration of steel tanks was the only area identified as needing further research.

(iv) Newfoundland

Concerns expressed in this province fall into two areas of equal magnitude, these being the need for approved disposal sites and the need for contractors to be registered to work on underground petroleum storage tank systems.

Contractors would like to see more research in the monitoring of cathodically protected tanks and tank testing procedures.

(v) Quebec

The general consensus from Quebec installers is the need for government approved contractors, and more specific regulations on installation of tanks and piping. Quebec's recently enacted "Petroleum Products Regulations" should offer contractors direction in these areas.

Contractors identified the installation of fiberglass piping in cold weather, double walled tank systems and installation techniques were areas in need of further research.

(vi) Manitoba

This province's contractors feel persons should be registered to work on underground petroleum storage tank systems and also expressed their need for disposal sites.

One contractor requested information on the status of underground petroleum storage tanks in other provinces (i.e. disposal, current regulations, etc.). Secondary containment systems were identified as needing further research.

(vii) Saskatchewan

Contractors here indicated their need for disposal sites of not only tanks, piping and sludges but also contaminated soils. Concerns for registration of contractors with the provincial government to perform work on underground petroleum storage tank systems was voiced.

An area identified as needing further research is the leak testing methods for underground storage tank systems.

(viii) Alberta

An installer in Alberta describes tank disposal as "a real problem". This seems to also hold true for disposal of contaminated soils and sludges. Contractors feel there is a need for provincial regulations to manage underground petroleum storage tank systems.

(ix) British Columbia

Questionnaires from B.C. contained the most detailed comments of all provinces. Contractors show concerns for the necessity of proper disposal sites and one noted "disposal of used underground gasoline storage tanks on Vancouver Island is a serious

problem". Mention was made for the necessity of contractors to be qualified and registered to work on underground petroleum storage tank systems. Concerns for safety during purging and cutting of tanks was expressed.

In areas needing further research, several subjects were mentioned including: double wall tankage systems, and inventory control devices in lieu of secondary containment. The reliability of tank testing methods currently utilized and tank testing for newly installed systems were also highlighted as in need of research.

(x) Ontario

Being the most populated province with the largest number of licensed installers, Ontario had the greatest questionnaire response.

In the area of disposal the following concerns were expressed:

- 1) Cleaning of tank interior.
- 2) Scrap dealers reluctance to accept underground petroleum storage tanks.
- 3) Methods to render tanks gas free.
- 4) Dangers during removal, purging and cutting of tanks.

The following were identified as areas where further research is necessary:

- 1) Tank containment systems.
- 2) Installation of cathodically protected tanks.
- 3) Double wall tankage systems.
- 4) Internal corrosion of protected steel tanks.
- 5) Soil testing.

The following were identified as concerns regarding general regulations:

- 1) Removal of in ground, out of service underground petroleum storage tanks is not being enforced as per regulations.
- 2) Use of unapproved materials during installations.
- 3) Shortage of provincial inspectors.
- 4) More stringent regulations on reporting of removals.
- 5) More stringent inspections of new installations.
- 6) Tank installers license too easily obtained.

Table No. II
Question #15
Disposal Methods Practiced for Tanks

PROV	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
NS	2.0	1.0	9.0	5.0	1.0	8.0	5.0
PEI	2.0	3.0	3.0	8.0	0.0	6.0	1.0
NFLD	1.0	1.0	0.0	2.0	0.0	4.0	0.0
NB	0.0	0.0	13.0	1.0	1.0	3.0	4.0
QUE	2.0	1.0	6.0	1.0	0.0	3.0	0.0
MAN	0.0	0.0	3.0	0.0	0.0	2.0	0.0
SASK	0.0	0.0	2.0	1.0	1.0	3.0	0.0
ALB	1.0	1.0	7.0	2.0	0.0	4.0	1.0
BC	2.0	0.0	5.0	2.0	3.0	0.0	1.0
ONT	4.0	3.0	27.0	4.0	4.0	34.0	3.0
TOTAL	14.0	10.0	75.0	26.0	10.0	67.0	15.0
%	6.5	4.6	34.6	12.0	4.6	30.9	6.9

Option 1 = Sell to farmers or Others
Option 2 = Resell for use as above ground storage of petroleum
Option 3 = Cut up and sell for scrap steel
Option 4 = Store tanks for ultimate disposal in the future
Option 5 = Send tanks to factory for refurbishing
Option 6 = Punch one or more holes in the tank and send to disposal site
Option 7 = Other

Figure #I
Graphical Representation of Options
Question #15

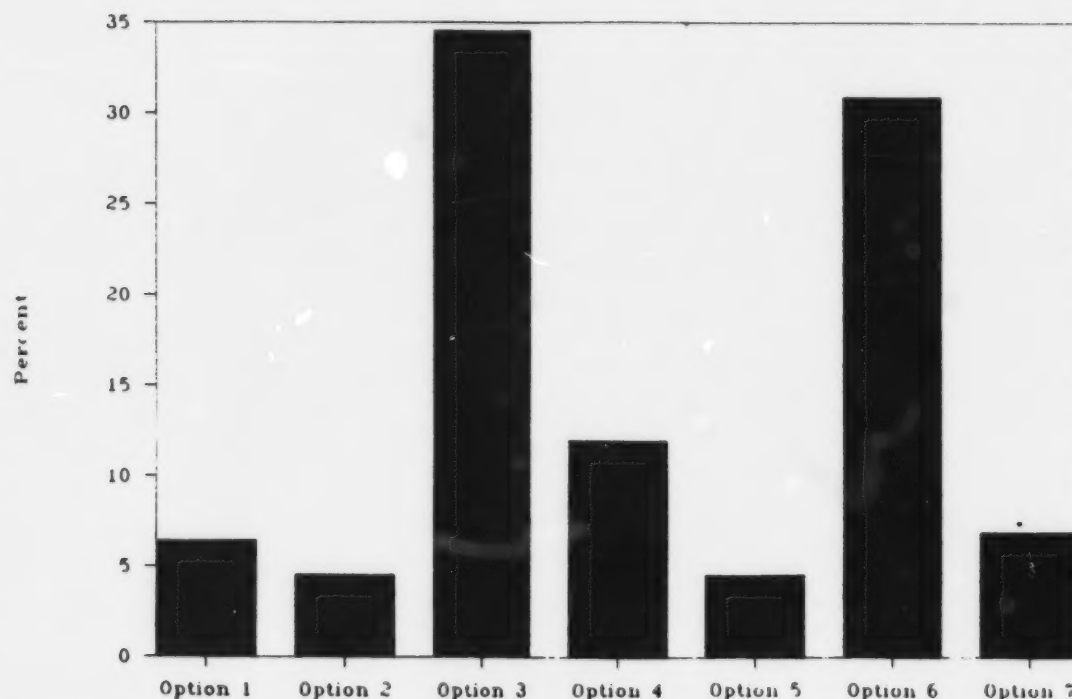


Table No.III

Question #21
Disposal Methods Practiced for Piping

PROV	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
NS	0.0	0.0	0.0	15.0	6.0	3.0
PEI	1.0	1.0	0.0	6.0	6.0	2.0
NFLD	0.0	0.0	0.0	2.0	2.0	1.0
NB	0.0	0.0	0.0	12.0	2.0	0.0
QUE	0.0	0.0	0.0	10.0	1.0	0.0
MAN	0.0	0.0	0.0	3.0	0.0	1.0
SASK	0.0	0.0	0.0	1.0	1.0	0.0
ALB	0.0	0.0	0.0	8.0	2.0	0.0
BC	0.0	0.0	0.0	6.0	2.0	1.0
ONT	3.0	1.0	0.0	39.0	5.0	9.0
TOTAL	4.0	2.0	0.0	102.0	27.0	17.0
%	2.6	1.3	0.0	67.1	17.8	11.2

Option 1 = Resell for use by interested individuals

Option 2 = Resell for use in aboveground petroleum storage

Option 3 = Resell for use in underground petroleum systems

Option 4 = Cut up and sell for scrap

Option 5 = Store for ultimate disposal in the future

Option 6 = Other

Figure #2
Graphical Representation of Options

Question #21

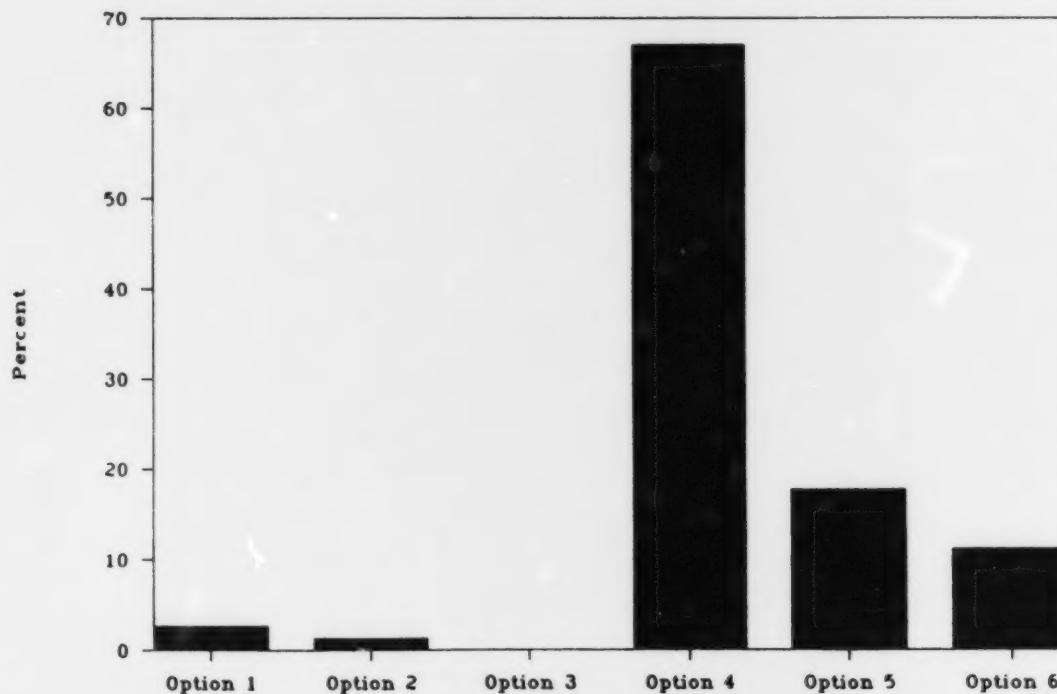


Table No. IV
Question #25
Disposal Methods Practiced for Tank Sludge or Scale

PROV	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
NS	7.0	0.0	1.0	2.0	0.0	7.0	0.0
PEI	3.0	0.0	3.0	0.0	2.0	1.0	2.0
NFLD	0.0	0.0	1.0	1.0	0.0	1.0	0.0
NB	2.0	0.0	3.0	3.0	2.0	6.0	2.0
QUE	0.0	0.0	0.0	1.0	1.0	4.0	0.0
MAN	0.0	0.0	0.0	0.0	0.0	2.0	0.0
SASK	1.0	0.0	0.0	0.0	0.0	2.0	0.0
ALB	3.0	2.0	5.0	0.0	0.0	2.0	0.0
BC	3.0	3.0	1.0	0.0	0.0	3.0	0.0
ONT	2.0	2.0	6.0	1.0	0.0	25.0	1.0
TOTAL	21.0	7.0	20.0	8.0	5.0	53.0	5.0
%	17.6	5.9	16.8	6.7	4.2	44.5	4.2

Option 1 = Place in sealed drums & store

Option 2 = Land spreading

Option 3 = Placed in sealed drums & deliver to provincially a
proved land disposal site for this material

Option 4 = Incinerate

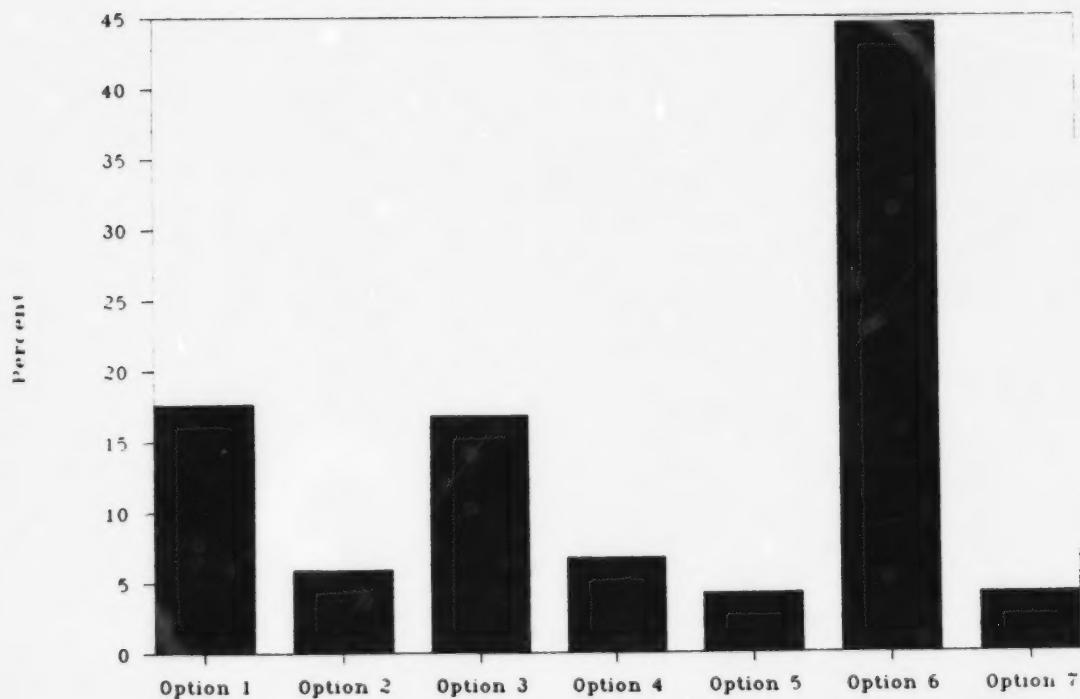
Option 5 = Mix with other waste & send to local garbage dispos
site

Option 6 = Hire a hazardous waste firm to disposal

Optino 7 = Other

Figure #3
Graphical Representation of Options

Question #25



D. Disposal Methods Practiced

Section C in the tank installers questionnaire deals with the disposal of removed tank systems. Under this section, seven options for tank disposal were listed, six options for disposal of piping and seven options for sludge disposal. The results received are listed by province and can be seen in Table II, Table III and IV respectively.

By examination of Figures 1 and 2, it is seen that most contractors are cutting tanks and piping and selling this as scrap steel. It was noted that the majority of contractors do not clean the interior of tanks that may have contained leaded gasoline. Some provinces do allow removed tanks to be accepted at landfill sites, and our results list this as the second most common disposal method. A number of contractors have indicated they store tanks for future disposal, and this reciprocates the need for tank disposal options.

During our quest for disposal options, interesting uses for these out of service vessels were brought to our attention during conversations with regulatory agencies throughout Canada and the U.S. This would indicate some of the usage that could be included in the "other" category. Farmers have been known to utilize these tanks as water troughs, cattle feeders and for watering crops. Others have been cut and used to resurface machinery blades. The most unusual use comes from Newfoundland where a tank was spotted being used as a storage shed, complete with windows, curtains and door.

In questionnaire Section D - "Disposal of Tank Sludges or Scale" contractors were provided with seven options for sludge disposal. These have been organized by province and the results may be examined in Table IV also. Figure 3 shows the most popular method to dispose of sludge is to hire a hazardous waste firm. As with the removed tanks, some jurisdictions do allow sludges to be accepted at landfill sites. Others store sludges for future disposal showing that contractors do not have access to a great number of options.

E. Discussion & Summary

Questionnaire results indicate contractors dispose of most tanks by two predominate methods: 1) as scrap steel and 2) at landfill sites.

Depending on the area in which the contractor resides, available disposal options may vary. For example, industrialized centers would offer greater options than rural areas. Scrap dealers are becoming more defined as to the condition in which they will accept these tanks; indeed some dealers charge on a per gallon basis for accepting tanks. With the introduction of the Superfund in the U.S., scrap dealers are very cautious where tanks are concerned, as dealers would be responsible for clean-up cost associated with releases from tanks.

The disposal of tanks at landfill sites varies with provincial regulations. For example, P.E.I. provincial landfill sites do not accept underground storage petroleum tanks, but Ontario and Nova Scotia have designed sites to accept such wastes under certain conditions. The proper local jurisdictions in each province would have to be contacted for their policies in acceptance of underground petroleum storage tanks at landfill sites.

Sludges prove to be as difficult to dispose of as tanks and piping. As with tanks, landfill acceptance of sludges varies with each province as seen in the questionnaire results, most contractors hire a hazardous waste firm.

Contractors, perhaps for lack of a better solution are storing tanks, piping and sludges for disposal in the future. This indicates that proper disposal options are needed. The questionnaire comments indicate contractors feel regulatory agencies should offer direction by initiating requirements or guidelines for disposal methods and facilities.

IV. TANK CLEANING & PURGING

A. Why Clean It?

The cleaning and purging of underground petroleum storage tanks are areas that must be addressed in relation to the disposal problem. During the purging or vapor freeing of tanks, flammable vapors may accumulate in the general area. Precautions must be taken to eliminate all sources of ignition in the area such as static electricity, smoking, vehicle sparks, etc. Carelessness and inexperience during removals has resulted in injuries and in some cases loss of life. This is iterated by a statement made in "Tank Corrosion Study", a report done in Suffolk County, Long Island, N.Y., which states under the heading of "Warning" - Tank abandonment is dangerous! During the time of this study there were three explosions of tanks and three fires which fortunately resulted in only two cases of minor injury. All accidents were caused by the extreme carelessness of the individuals working on the tanks. They result from the use of torches or abrasive cutting tools on tanks where they should not have been used". Two incidents which resulted in death can be found in Appendix B. Why clean it can be answered in one word - safety.

Comments from contractors reflect concerns in handling tanks, especially if they contain Class I liquids. One contractor in Quebec commented, "one of these days someone will blow up if nothing is done". An Ontario contractor attached a letter to his returned questionnaire expressing his concerns for safety during removals.

The October, 1986 issue L.U.S.T.L.I.N.E., recounts a fatal tank removal accident in Portland, Maine. This incident prompted a memo entitled "Precautions During Tank Removal" to be issued by the state to certified underground storage tank installers which advises: "Department of Environmental Protection regulations which specify the on-site gas freeing of tanks should be disregarded if there is any possibility of this operation causing a threat to public safety". A death occurred in B.C. while cutting a 22,730 litre gasoline tank with torches. The force from this explosion threw the man 43 metres through the building roof.

Many contractors now removing underground storage systems are not registered with regulatory agencies nor are they given instructions on removal. Safety concerns have been expressed by the contractors in our questionnaire.

A person in an unidentified U.S. State uses a dangerous method to gas free underground petroleum storage tanks. Tanks are accepted after removal, taken to a field on a farm, a stick of dynamite is dropped in the tank, the explosion usually results in the ends being blown out. The tanks are then considered to be vapor free and may be sold to scrap dealers. This procedure is certainly not an acceptable method for tank disposal.

Leaded gasoline itself consists of a diverse mixture of more than 276 aromatic, cycloparaffin, and branched paraffin hydrocarbons, along with tetraethyl lead. (Robison, et al, Feb. 1988). Therefore tanks containing leaded gasoline should have their interior cleaned prior to disposal.

In the interest of both safety and environmental protection, prior instructions should be made available to contractors considering the dangers involved during removals. Liability insurance for tank removal contractors should be made mandatory.

B. Purging Methods

National Fire Prevention Association (NFPA) 30, Appendix B addresses removals as follows: "Disconnect piping at all tank openings. Remove section of connecting lines which are not to be used further and cap or plug all tank openings. After removal, the tank may be gas freed on the premises if it can be done safely at that location, or may be transported to an area not accessible to the public, and the gas freeing completed at this location". Maine's Environmental Department has very detailed regulations for purging tanks which contain Class I liquids. These tanks are to be inerted prior to removal by using dry ice. Other techniques may only be used with the expressed written approval of the Department of Environmental Protection and the State Fire Marshal's office.

The decision to gas free petroleum storage tanks prior to or after removal, seems to be left up to contractors in most areas. Our questionnaire results indicate the majority choose to gas free tanks prior to removal.

It is evident then, that the first factor to be considered in the removal of tanks is safety. Purging before or after removal should only be decided after the safety factor has been taken into account. Tanks which have been purged should always be verified to be vapor free by using an explosimeter. Contractors should note that most regulations require the use of such a meter. The use of pneumatic cutting tools, rather than torches would lessen the danger of explosions.

The results of the questionnaire show contractors choose to purge tanks using several different methods. Dry ice was the most widely used of the six listed in our questionnaire and filling the tank with water proved to be the least common method. Purging with air came in second place and steam cleaning was a close third. Nitrogen gas was fourth.

The popularity of dry ice (carbon dioxide) can be attributed to its simplicity of use and relative safety. After crushing, it is distributed evenly over the greatest possible area inside the tank, thus requiring little or no equipment. This method is probably more economical for smaller tanks than larger ones. Recommended use varies between 2 lbs. per 100 gallons and 1.5 lbs. per 100 gallons, thus purging a 10,000 gallon tank using 2 lbs. per 100 gallons could cost approximately \$700. Purging by use of carbon dioxide and air could

cause a build up of static electricity and any vehicle attached to the tank and piping should be grounded to prevent any ignition of flammable vapors. At least one storage tank volume of nitrogen gas is necessary to purge an underground storage tank. Steam is relatively economical and safe method to purge tanks when contractors have means to dispose of any remaining waste water (i.e. oil water separators).

Dry ice, steam, and nitrogen gas seem to be the most viable methods of purging underground petroleum storage tanks. These methods seem to generate the least amount of additional waste and to be the safest in terms of ignition sources.

C. Cleaning Tank Interior

Following the purging process and prior to delivery to scrap yard dealers or for other intended uses, all sludges or tank bottoms should be removed. Depending on the age, size, condition and product stored the amount of sludge varies. One example cited was for a 5,000 imperial gallon gasoline tank which has been removed of product to its lowest drain off point could contain approximately 30 lbs. of sludge. If the tank contained leaded gasoline at anytime during its lifespan, the interior should be thoroughly cleaned.

Several methods have been identified to accomplish the removal of lead traces, of these abrasive blasting and scraping with wire brushes appear to be the most commonly used. American Petroleum Institute (API) publication 2202, section 3.3.2 states "Abrasive blasting or power wire brushing are methods that will sufficiently clean metal for flame cutting without positive pressure air supplied respiratory equipment". This publication also advises in section 4.4.2 that if steel is to be sold for scrap and possible remelting in the manufacture of new steel, all interior surfaces of any plates that have been in contact with sludge should be abrasive or wire brushed to bare metal. A number of tanks were also coated with a paint containing lead, and this should be removed prior to disposal. Most removed tanks may have to be treated as having contained leaded gasoline, since making a distinction can be difficult. Contractors will find most scrap yard dealers are more willing to accept tanks cleaned in this manner.

V. DISPOSAL OPTIONS FOR TANKS AND PIPING

A. As Scrap (Recycling)

The recycling of condemned underground petroleum storage tanks as scrap metal has proven to be the most commonly utilized disposal method. The tanks are sold to a scrap dealer, who in turn delivers these to be recycled at foundaries or steel mills. In recent years, restriction on air pollutants and stack emissions have caused scrap processors to become increasingly particular when accepting tanks for recycling. Such things as epoxy coatings, lead deposits, exterior lead paint, and interior linings will influence the acceptance of tanks as well as the price paid. Prices paid for steel tanks with ends removed or punctured were from \$10. - \$25. per ton and for tanks cut into oversize scrap prices ranged from \$55. - \$85. per ton. A questionnaire was circulated to scrap dealers in each province and this may be found in Appendix C.

Proper cleaning and conditioning of these vessels serves to make them more appealing to scrap dealers and also pose less potential for explosion during the cutting process. Information received from a questionnaire and phone conversations, noted that most scrap dealers will only accept tanks when the ends have been removed or have several punctures. Many dealers are not interested in accepting whole underground petroleum storage tanks in any condition. Mass. Tank Disposal, Chicopee, Massachusetts quoted a price of \$125 to accept a 1,000 gallon tank (with a nominal amount of sludges) for cleaning and subsequent sale as scrap. Prices for similar service at Sunnybrae Cleaners in Moncton is \$150 for 1,000 gallon tank.

The Institute of Scrap Iron & Steel (I.S.I.S.) in Washington, D.C., offers guidance to scrap dealers on related issues. In July of 1987 a list entitled "Suggested Operating Practices for Materials on the I.S.I.S. Alert List" was issued to caution dealers on the acceptance of fuel and chemical storage tanks. The guidelines (see Appendix D) address the potential for contamination and explosions when accepting such tanks. The I.S.I.S. do feel this is a good economic time for scrap dealers, but underground storage tanks are only marginally profitable due to high cutting costs.

Despite the costs and efforts necessary to render tanks acceptable as scrap metal, recycling is the most viable disposal technology presently available. Recycling remains the only option that will ensure underground petroleum storage tanks cause no further liabilities.

B. Landfilling

Contractors indicate this option to be a popular method of tank disposal. Questionnaire results show substantial numbers are delivered to landfill sites designated to accept such wastes.

Tanks that are accepted for disposal at landfill sites usually are free of sludges, vapors, product and have the ends punctured or removed. They are then crushed and covered with fill. The interior cleaning process would not be required, thus making this more economically appealing than recycling. In future, landfill sites may not be able to accommodate the increasing number of tanks being removed, due to space restrictions. Presently landfill sites in the U.S. charge to accept items such as tanks and piping; although in Canada this practice has not been initiated.

Landfilling as a disposal option, is economical and relatively non-time consuming. Tanks that have not been properly cleaned, residues from tanks, piping and tank coatings all become potential threats to ground and surface water sources.

When environmental issues are considered recycling is a more favorable disposal option than landfilling.

C. Refurbishing

Various refurbishing techniques such as interior linings, and exterior coatings are now available as alternatives to removing or disposing of tanks. The questionnaire results indicate few contractors choose this option.

Underwriters' Laboratories of Canada (ULC) has published the following Technical Supplements on the Refurbishing of Underground Tanks for Flammable and Combustible Liquids: CAN4-S605(A) Refurbishing of Steel Underground Tanks for Flammable and Combustible Liquids, June 1987.

CAN4-S615(A) Refurbishing of Reinforced Plastic Underground Tanks for Petroleum Fuels, February, 1987.

Each refurbished tank, constructed in accordance with the requirements in these technical supplements bears, in addition to the original ULC label, the label of Underwriters' Laboratories of Canada which identifies the tank as a refurbished tank.

A number of tank manufacturers have been authorized by ULC to apply this ULC label to refurbished tanks.

Internal lining of underground storage tanks is addressed in PACE 82-3, section 6 and also in American Petroleum Institute publication 1631. The latter publication address the subject under the following sections:

- 1) General
- 2) Preparation for Opening the Tank
- 3) Tank Entry

- 4) Preparation of the Tank Interior
- 5) Application of Lining
- 6) Tank Closing

Tank owners may choose to purchase a new tank in lieu of refurbishing costs. Refurbishing would depend on the degree of interior and exterior corrosion the tank exhibits.

D. Reuse

The reuse of underground petroleum storage tanks is not a popular option with contractors or regulatory agencies. In Manitoba, a problem has been experienced when reused tanks are inspected by the regulatory agency and do not meet current standards. Assessment of the condition of the tank should be carried out prior to use in above ground storage of petroleum. Few contractors indicated reuse as a disposal method, and thus indicating there is a minimal demand.

Tanks are being used as culverts, cattle feeders, in sewage disposal systems and in above ground storage of petroleum. To establish that tanks have been properly cleaned prior to use, proves to be a most difficult task. For this reason, use as cattle feeders and in sewage disposal systems would not be recommended. Further study would be necessary for these areas to be proven environmentally acceptable. In PACE Report No. 82-3 Underground Tank Systems Review of State of the Art and Guidelines, section 9, 11-A deals with the suggested procedure for reuse where regulations permit.

VI. DISPOSAL OPTION FOR SLUDGES

A. General

Sludges or tank bottoms tend to be more difficult to dispose of than the removed tanks. Bottom sludges have been described as "a complex mixture of sediments and insoluble mixed hydrocarbons produced in part of the microbial degradation of petroleum in the presence of water. When occurring in tanks used to store leaded gasoline, it may have an organic lead concentration high enough to qualify as a hazardous waste. By no means a consistent phenomenon in gasoline tanks, sludge formation is most common in poorly maintained tanks, those with a low flow through rate, or those that have frequently received poor quality product. It occurs more often in tanks storing diesel fuel, kerosene, jet oil, and other heavier products". (Robinson, et al, Feb. 1988). The content of the sludge and the regulations applicable in each province are the two determining factors used to classify wastes as hazardous or non-hazardous.

Questionnaire results indicate most contractors hire a hazardous waste firm to dispose of sludges. These firms charge on a per gallon basis, plus mileage and pumping time. A listing of firms that supply hazardous waste services may be found in "Directory of Hazardous Wastes Services" available from Corpus Information Services, 145 Don Mills Road, Don Mills, Ontario, M3B 2X7 or phone 1-800-268-7742 (in B.C. 112-800-268-7742). This directory includes a listing of firms across Canada, their phone numbers and a contact person. Several firms were contacted for information, including one each in southern Ontario and Nova Scotia. Both these firms provide a hazardous waste pickup service. It should be noted that most firms test tank sludges for content (i.e. lead) prior to giving prices for disposal. After analysis and collection, these firms dispose of sludges in several ways including:

- 1) Mix with lighter fuels and sell as a heavier class fuel.
- 2) Deliver to facilities capable of incinerating sludge.
- 3) If considered non-hazardous, may be landfilled (depending on provincial regulation).

The cost to refine tank sludge is extremely expensive and hazardous waste firms rarely use this method to dispose of sludges.

A sample price listing provided by a Canadian hazardous waste firm to dispose of sludge is included in Table V.

TABLE V

PRICE TO DISPOSE OF SLUDGE BY HAZARDOUS WASTE FIRM

I. PUMPABLE SLUDGES

Description I.D. Product Group 004	Drums (205 Litres Max.) Drum Content Price	Bulk Shipments Price Per Metric Ton
A. Petroleum	\$557.50	\$ 698.50
B. Other	\$759.00	\$ 913.00
D. Dangerous	\$863.50	\$1,034.00

II. SOLIDS

Description I.D. Product Group 005	Drums (205 Litres Max.) Drum Content Price	Bulk Shipments Price Per Metric Ton
A. Organic	\$632.50	\$1,650.00
B. Inorganic	\$412.50	\$ 577.50

Mass. Tank Disposal in Chicopee, Massachusetts, USA, charges \$1.50 per gallon for liquid sludges and \$4.50 per gallon for solids, when tanks are cleaned at their facility.

Sludge disposal methods identified through our research, were landfilling, waste oil pits, incineration. These are discussed below.

B. Enhanced Land Treatment

Much literature is available on the subject of land treatment of petroleum industry sludges. Land treatment has been utilized by oil refineries in Canada, U.S. and Europe since the 1950's and is mainly used to dispose of sludges produced on site. In recent years, the amount of sludge disposed of by this method is increasingly significant. With increasing use, land treatment techniques have become more modified thus more efficient and successful.

This technique can be adapted to most areas of Canada, although the application of sludges does not take place during the winter months. Hydrocarbon decomposition by microorganisms is initially a rapid process; thus allowing for several applications during the season, depending on the oil and water concentrations of the applied sludges. Fertilizers are added to the soil to provide nutrients, as with any farming operations. PACE Report 81-5A entitled "Landspreading of Sludges at Canadian Petroleum Facilities" discusses landspreading of sludges in detail and section 2.4 discusses "Trends in Disposal of Petroleum Industry Sludge".

Properly planned, controlled and monitored landtreatment sites would be an excellent disposal option for tank sludges.

C. Incineration

Disposal of sludges by means of incineration, although once a popular method, has now greatly diminished. Environmental restrictions on air emissions and complaints of pollution in industrialized centers, have played a role in its decreasing popularity. Very few contractors indicated their use of this disposal method, probably due to a lack of such facilities.

A large quantity of sludges collected in the Maritimes, Quebec and Ontario are disposed of by incineration at facilities in Sarnia, Ontario or Ville Mercier, Quebec. Sarnia's facilities include a liquid injection, high temperature incineration system for organics and inorganics and a secure chemical landfill site. The Ville Mercier site has a high temperature incinerator capable of handling organic substances. Both these sites are operated by Tricil Ltd.

Incineration at government appointed facilities is an acceptable disposal option, but is not readily available to contractors.

D. Waste Oil Pits and Landfilling

Both these methods of sludge disposal are currently in use across Canada and a significant number of contractors indicated their use of landfilling. In the Yukon, sludges and waste oil are disposed of at waste oil pits, but this method is now meeting with public disapproval. Several provinces have designated landfill sites to accept sludges. Landfilling of sludges does not promote the degradation of hydrocarbons as land treatment does. Lack of suitable landfill sites, and the cost required to upgrade existing sites to environmental standards (such as new EPA Regulations affecting landfills in the U.S.) may cause a downward trend in this method.

Landfilling as presently practiced is a disposal method that is not without environmental risks.

VII. RECOMMENDED DISPOSAL METHODS AND ASSOCIATED COSTS

A. For Tanks & Piping

After examination of the available options (i.e. landfilling, refurbishing and reuse) selling for scrap has been determined to be the most viable option.

Contained in our questionnaire were names of scrap dealers contractors have dealt with when disposing of tanks. A listing of these dealers is provided in Appendix E. This is not a complete list of dealers who will accept cut up tanks. Should contractors be interested in doing business with any dealers on the list, they are advised to first contact the dealer to obtain their policy for acceptance of such materials. Prices paid for underground petroleum storage tanks when sold for scrap will tend to vary with market demand. In the foreseeable future, contractors or tank owners may encounter a situation where scrap dealers will charge for accepting these tanks.

For disposal as scrap to be environmentally safe, it must be done in the proper manner, and this requires the use of appropriate facilities. To ensure tank disposal facilities are properly located, designed and equipped, regulatory agencies must have applicable guidelines. Private industry could be encouraged to operate such facilities, if all unreuseable underground petroleum storage tank systems were required to be disposed of in this manner. An ideal situation would exist in Canada when all removed tanks are disposed of at proper facilities accessible to all contractors.

(i) Recommended Guidelines for Establishing Tank Disposal Facilities

(a) Introduction

Site locations for tank disposal facilities should be selected with great care. It would not be recommended to situate such facilities in hydrogeologically sensitive areas. Criteria have been set down on P.E.I. for such areas, being described as within 200 metres of a well or wells with a total yield of 200 Igpm or greater. P.E.I. has also listed six (6) regions as "Protected Watershed" areas. Provinces who have not addressed the issue of area sensitivity may wish to do so prior to giving approval of tank disposal sites. Potential releases from such sites, when located in sensitive areas could cause irreversible damage to water supplies. The following guidelines are recommended for the establishment of "Tank Disposal Facilities". One should be aware that the National Fire Code of Canada, section 3.5 addresses salvage shops and yards.

(b) General Considerations

1. Located in an area approved by the regulatory agency and all applicable jurisdictions, and not to be located in areas classified by the agency as "sensitive".
2. The site must be made inaccessible to unauthorized persons (i.e. fence, gate).
3. Signs to be posted, visible to the public with letters not less than 4" in height, stating "CAUTION - FLAMMABLE MATERIALS".
4. The site must be graded and graveled.

(c) Receiving Tanks

1. The site operator shall have training and experience in the handling and storage of flammable liquids.
2. The site operator shall issue a receipt for each tank accepted for disposal.
3. A record of tanks accepted and the date of disposal of the tank shall be maintained on the premises.

(d) Safety Considerations

1. A minimum 10 foot, but preferably 25 foot fire protection buffer shall be cleared of combustible materials on all sides of the facility.
2. The facility shall be equipped with sufficient fire protection equipment as deemed necessary by local fire officials.
3. An "Emergency Response Plan" must be in place with trained personnel and emergency response equipment and materials on site.
4. An explosive meter shall be used to verify tanks are vapor free prior to cutting.

(e) Containment Provisions

1. The site must have a reinforced concrete pad sufficient to accommodate the largest tank to be encountered, sloped to a drain leading to an oil/water separator. The oil/water separator must be liquid tight and emptied of petroleum products as necessary. A written record of pump outs from the oil/water separator shall be maintained on the premises.
2. Effluents from the oil/water separator shall be kept in a holding tank and tested for hydrocarbons and other contaminants prior to release. Effluent quality must meet the minimum standards established by the regulatory agency.
3. Tank sludge shall be stored in sealed drums and disposed of in a manner approved by the regulatory agency.
4. Tanks will be cleaned and emptied of residue and sludge as quickly as possible upon arrival on site.
5. Immediate action should be taken to contain all releases from tanks stored on site.
6. All run-off from the cleaning operation shall be contained on site.

B. For Sludges

Options for sludge disposal are extremely limited in all provinces of Canada. Research to determine viable methods of sludge disposal that could be made accessible to contractors is certainly necessary. The quantity of sludge in need of disposal will increase in proportion to tank removals and regulatory agencies will be in need of policies on this matter to ensure proper disposal. Acceptable method for sludge disposal are currently by land treatment and incineration. The accepted practice is to hire a hazardous waste firm to conduct this disposal. This appears to be the best option available at present.

C. Disposal Costs

The cost to dispose of underground petroleum storage tanks and sludges by the options available in Section C and D of the questionnaire are listed in Table No. VI. Prices listed in each column are an average of the prices submitted by contractors in the provinces indicated. A high and low price is also shown, and the price variances can be noted here.

Table VI

QUESTIONNAIRE RESULTS: AVERAGE PRICES LISTED

TO DISPOSE OF 1000 GAL STEEL TANK AND ASSOCIATED SLUDGES

	AVERAGE PRICE TO DISPOSE OF TANKS	AVERAGE PRICE TO DISPOSE OF SLUDGE	TANK		SLUDGES	
			HIGH	LOW	HIGH	LOW
PROV.						
N.S.	\$526.00	\$363.00	\$1,000	\$205	\$700	\$50
P.E.I.	\$346.00	\$475.00	\$1,500	\$75	\$800	\$150
NFLD.	\$850.00	\$500.00	\$1,800	\$100	\$500	\$500
N.B.	\$386.00	\$302.00	\$2,000	\$100	\$1,000	\$50
P.Q.	\$179.00	\$200.00	\$350	\$50	\$400	\$50
MAN.	\$138.00	\$75.00	\$200	\$75	\$75	\$75
ALBT.	\$579.00	\$370.00	\$1,000	\$300	\$800	\$100
SASK.	\$450.00	\$500.00	\$500	\$400	\$500	\$500
B.C.	\$350.00	\$300.00	\$500	\$200	\$500	\$100
ONT.	\$351.00	\$373.00	\$1,700	\$30	\$100	\$50

Price variances can be explained by the numerous factors that must be taken into account before contractors price each removal. The factors to be considered would be:

- a. Product tank contains (both quantity and type).
- b. Method used to purge tank.
- c. Amount of sludge tank contains.
- d. Distance contractor travels to site of removal.
- e. Tank size.
- f. Depth of cover.
- g. Accessibility of tank location.
- h. Length of piping run to be removed.
- i. Should contamination be present, clean up costs would be separate.
- j. Methods used to dispose of tank and sludge.

As can be seen, these factors would create wide variances in removal prices. Experienced contractors we have contacted will require that such information be supplied prior to giving prices.

A recent study conducted in the United States also examined the cost for disposal service related to underground tanks. Table VII is taken from this report and reflects the average costs for tank and sludge in the United States (Robinson, et al, February, 1988). The cost given on Table VII shows that disposal costs in the United States are significantly higher than the prices listed by contractors during this survey. This suggests that Canadian disposal prices will increase in the future.

TABLE VII

SAMPLE 5,000 GALLON TANK

REPORTED COSTS OF DISPOSAL SERVICES

I. Full Service		
Firm	Option	Cost
1	removal, recycle	\$2,200 - \$2,700
2	removal, recycle	\$2,550
3	removal, recycle	\$9,000
4	removal, landfill, hazardous	\$5,000
5	removal, landfill, hazardous	\$6,915
6	abandon in place	\$2,900 - \$5,250
7	abandon in place	approx. \$5,000

II. Partial Contracting: Tank Cleaning and Disposal		
Firm	Technology	Cost
1	chemical clean and recycle	\$350
2	steam clean and recycle	\$350
3	steam clean and recycle	\$400
4	landfill, hazardous	\$3,150
5	landfill, hazardous	\$390
6	landfill, hazardous	\$2,150

Costs are for vessel delivered to facility.

CONDITIONS

TANK: Single 5,000 gallon steel tank.

BURIAL: Under 6 inches of concrete and 30 inches of compacted fill.

CONTENTS: 50 gallons of leaded gasoline and 50 gallons of sludge.

LOCATION: Tank and backfill entirely above water level.

ADOPTED FROM: Underground Storage Tank Disposal: Alternatives, Economics and Environmental Costs (Robinson, et al, Feb., 1988).

VIII. RECOMMENDATIONS

A. For Tank & Piping

- 1) The only recommended method presently available to dispose of unreuseable underground petroleum storage tank systems is to sell as scrap steel.
- 2) Tank removals should only be conducted by qualified contractors registered or licensed with the appropriate regulatory agency.
- 3) Prior to disposal as scrap steel, all tanks must be properly cleaned.
- 4) Underground Petroleum storage tank systems should be cleaned and prepared for scrap at a facility capable of performing this process in an environmentally safe manner.
- 5) Such facilities (Tank Disposal Sites) should have the approval of the provincial regulatory agency.
- 6) Regulatory agencies should adopt "Guidelines" prior to approval of Tank Disposal Facilities.

B. For Sludges

- 1) Sludges should be disposed off by a hazardous waste firm approved by provincial agencies.
- 2) Agencies should be aware of the disposal methods practiced by such firms.
- 3) The methods of land treatment and incineration under proper conditions be continued as methods of sludge disposal.
- 4) Regulatory agencies should make their policy on sludge disposal known to contractors.
- 5) Immediate research is necessary to identify other acceptable methods of sludge disposal.

IX. REFERENCES

- Alberta. Fire Prevention Act. Alberta Fire Code (151/84, 135/86).
- American Petroleum Institute. Interior Lining of Underground Storage Tanks API 1631, 1987.
- American Petroleum Institute. Removal and Disposal of Used Underground Petroleum Storage Tanks API 1604, 1987.
- American Petroleum Institute. Guidelines for Protecting Against Lead Hazard When Dismantling and Disposing of Steel from Tanks That Have Contained Leaded Gasoline API 2202, 1982.
- Delaware. Regulations Governing the Control of Underground Storage Tanks, Department of Natural Resources and Environmental Control, State of Delaware, 1986.
- Directory of Hazardous Waste Services. Corpus Information Services. 1450 Don Mills Road, Don Mills, Ontario.
- Environmental Code of Practice for Underground Storage Tank Systems Containing Petroleum Products, Ottawa, Ontario, 1988.
- Freeman, J. T. and R. P. Innes. 1987. Enhanced Microbial Decomposition of Hydrocarbons in the Unsaturated Zone - A Feasibility Study. Prep. for Research Management Division, Alberta Environment by Standley Associates Engineering Ltd., RMP Report 87/85.
- Institute of Scrap Recycling Industries Inc., Suggested Operating Practices for Materials on the ISIS/NARI "Alert List", July, 1987.
- Long Island, N.Y. Tank Corrosion Study, Suffolk County Department of Health Services, County of Suffolk, Long Island, New York, 1988.
- Leaking Underground Storage Tank Line, New England Interstate Water Pollution Control Commission, Boston, Massachusetts, Bulletin 4, October 1986.
- Maine. Department of Environmental Protection. 1986. Regulations for Registration, Installation, Operation and Abandonment of Underground Oil Storage Facilities.

- Maine. Department of Environmental Protection. Policy on Underground Oil Storage Regulations, Guidelines for Underground Tank Disposal Facilities. (06-096 CMR 691.(8)(b)(2), January, 1988.
- Manitoba. The Environment Act Regulation 97/88R (Bill 26, Chapter 26), January, 1988.
- Manitoba. The Environment Act. (C.C.S.M.C.E125). Storage and Handling of Gasoline and Associated Products Regulations. (97/88R, Jan. 19, 1988.
- Massachusetts. Commonwealth of. Provisions for Approving Underground Steel Storage Tank Dismantling Yards. 1985. (502. CMR. 300).
- National Fire Protection Association (NFPA) 30 Flammable and Combustible Liquids Code, Quincy, Massachusetts, 1984.
- New Brunswick. Petroleum Product Storage and Handling Regulation, Clean Environment Act, Department of Municipal Affairs & Environment, July 19, 1987.
- New Brunswick. Petroleum Storage Tank Decommissioning Process, Department of Municipal Affairs & Environment, 1988.
- Newfoundland. Department of the Environment, 1982. The Storage and Handling of Gasoline and Associated Products Regulations 271/86.
- New York State. Department of Environmental Protection. Permanent Closure of Petroleum Storage Tanks, July, 1988.
- Nova Scotia. Dangerous Goods and Hazardous Waste Management Act, Petroleum Storage Regulations. (Section 12, Chapter 7), 1986
- Ontario. Gasoline Handling Act Regulation 439. January, 1985.
- Petroleum Association for Conservation of the Environment (PACE), 1201 -275 Slater Street, Ottawa, Ontario. Landspreading of Sludges at Canadian Petroleum Facilities, Report 81-5A, 1981.
- PACE. Underground Tank Systems. Review of State of the Art and Guidelines, Report 82-3, February, 1983.
- PACE. Manual for Landspreading of Petroleum Industry Sludges, Report 81-5B.
- Quebec. Petroleum Products Regulations. Ministere de l' Energie et des Ressources, Quebec, 1987.

Prince Edward Island. Environmental Protection Act. Petroleum Storage Tanks Regulations, Department of the Environment, Charlottetown, P.E.I., 1986.

Saskatchewan. The Environment Management and Protection Act. The Hazardous Substances Regulations. (Section 38), Saskatchewan Environment and Public Safety, 1988.

Vermont. Underground Storage Tank Regulations. Waste Management Division, Department of Environmental Engineering, Waterbury, Vermont, 1987.

Virginia. Underground Storage Tank Disposal, Alternatives, Economics and Environment Costs. Water Resources Research, Blacksburg, Virginia, 1988.

Yukon. Gasoline Handling Ordinance, Office of the Commissioner, Yukon Territory, April, 1972.

CONTACTS

Bauman, Bruce, American Petroleum Association, Washington, D.C.

Bell, Kit, Fire Marshal's Office, North West Territories

Brazell, Terry, State Water Resources Board, State of California

Brendon, Jay, Dept. of the Environment, Province of Nova Scotia

Canfield, Harry, Fire Prevention Branch, Province of Alberta

Chandler, Bob, Fire Prevention Branch, Province of Alberta

Chang, Victor, Spill Response and Control Section, Dept. of the Environment, Province of Saskatchewan

Cowan, Dick, Dept. of Environment, State of New York

Creed, Roy, Creed's Petroleum Maintenance, Charlottetown, P.E.I.

Department of Water Resources, State of Vermont

Dollemont, J., Sunnybrae Cleaners, Moncton, N.B.

Dutton, John, Dept. of the Environment, Province of Newfoundland

Ellison, Russ, Virginia State Water Board, State of Virginia

French, Vince, Inland Environmental Services, Dartmouth, N.S.

Green, M., British Columbia Petroleum Association

Hipperson, Larry, Protective Services Branch, Dept. of Community & Transport Services, Yukon

Hore, Ron, Dept. of the Environment, Province of Ontario

Kaselis, Rick, Dept. of Environmental Protection, State of Maine

Keshvani, Ali, B.C. Dept. of the Environment, Province of British Columbia

Liquid Waste Services & Systems Ltd., Brockville, Ontario

Mazerolle, Morris, Dept. of Environment and Workplace, Province of Manitoba

McIver, Al, Fuels Safety Branch, Province of Ontario

Mooney, Greg, State Fire Marshal, State of Massachusetts

Mouyard, Kevin, Dept. of the Environment, State of Maryland

Muffler, Alan Cpl., Office of the Fire Marshal, State of Pennsylvania

Omushask, Emile, Dept. of Environmental Control, State of Delaware

Paquet, Michel, Dept. de l'Energie et des Ressources, Province of Quebec

Perguide, V., Mass. Tank Disposal, Chicopee, Massachusetts

Pim, Jim, Dept. of Health Services, County of Suffolk, Long Island, N.Y.

Truman, Bill, Dept. of Environment, State of Florida

Wassum, Dave, Institute of Scrap Iron and Steel, Washington, D.C.

Weaver, Mike, Virginia State Water Board, State of Virginia

APPENDIX "A"

Blank Tank Installers Questionnaire

Community & Cultural Affairs

Government of Prince Edward Island
P.O. Box 2000 Charlottetown, P.E.I. C1A 7N8
11 Kent Street Tel: (902) 892-0311

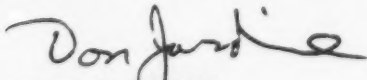
Dear Underground Tank Installers:

You have been identified as a possible installer (or remover) of underground petroleum storage tank systems. We are conducting a Canada wide survey in conjunction with Environment Canada to obtain more information on these systems, especially in regard to the problem of ultimate disposal of removed tanks and piping. A number of tank installers have complained that acceptable tank disposal methods have not been identified by government authorities.

We invite you to participate in the enclosed questionnaire. First we ask you to answer the questions given and then to address any issues you wish to bring to our attention. It is only through your input that we can find solutions which you in the industry can help to solve this problem.

We ask that this questionnaire be returned to our office in the enclosed self addressed envelope by December 16, 1988.

Yours truly,



DON JARDINE
Water Resources Branch

A. GENERAL

- ## B. TANK SYSTEM REMOVAL

7. How many tanks have you removed in the last year?

8. Do you gas free the tanks? Yes _____
No _____

If your answer is no, please skip to question #13.

9. If you have answered Yes to question #8, when do you gas free the tank? Before Removal _____
After Removal _____
10. What method(s) do you use to gas free the tanks? (Check all that apply.) Dry Ice _____
Steam _____
Fill with water _____
Nitrogen Gas _____
Air _____
Other _____
11. When vapors are being displaced, they are expelled from the tank through the vent opening, do you? (Check all that apply.) Vent vapors away from area _____
Make sure that there are no ignition sources in or near the area _____
Prohibit persons from entering the excavation area during this work _____
12. Do you gas free the piping when systems are being removed? Yes _____
No _____
13. Do you abandon tanks in place? Yes _____
No _____
14. If you answered yes to question #13, what methods do you use? (Check all that apply.) Leave empty _____
Fill with sand and cement mixture _____
Fill with sand only _____
Fill with cement only _____
Other _____

C. DISPOSAL OF REMOVED TANK SYSTEMS

15. What methods do you use to dispose of removed tanks?
(Check all that apply.)

Sell to farmers or other interested parties _____
Resell for use as above ground storage of petroleum _____
Cut up and sell for scrap steel _____
Store tanks for ultimate disposal in the future _____
Send tanks to factory for refurbishing _____
Punch one or more holes in the tank and send to a disposal site _____
If sold for scrap, do you sand blast inside face of steel to remove lead dust _____
Other _____

16. Do you operate a facility for cutting up tanks?

Yes _____
No _____

17. Do you deliver removed tanks to a facility which cuts up tanks?

Yes _____
No _____

18. If you answered yes to question #17, what is the name & address of the facility?

Name: _____
Address: _____
Telephone: _____

19. Are you aware of any other facilities which recycle removed tanks?

Yes _____
No _____

20. If you answered yes to question #19, what is the nature, name and address of this facility?

Nature of Business: _____
Name: _____
Location: _____

21. How do you dispose of removed piping?

Resell for use by interested individuals _____
Resell for use in above ground petroleum storage systems _____
Resell for use in underground petroleum systems _____
Cut up and sell for scrap _____
Store for ultimate disposal in the future _____
Other _____

22. Do you include the disposal cost for a tank system when estimating a job?

Yes _____
No _____

23. If you answered yes to question #22, what is the approximate cost for a 1000 gal tank?

\$ _____

D. DISPOSAL OF TANK SLUDGE OR SCALE

24. Do you remove the sludge or scale from a removed underground petroleum storage tank?

Yes _____
No _____

25. If you answered yes to question #14, what do you do with the sludge you remove from these tanks?

Place in sealed drums and store _____
Land spreading _____
Place in sealed drums and deliver to a provincially approved land disposal site for this material _____
Incinerate _____
Mix with other waste and send to local garbage disposal site _____
Hire a hazardous waste disposal firm to dispose _____
Other _____

26. Do you include the disposal cost for tank sludge and scale when estimating a job?

Yes _____
No _____

27. If you answered yes to question #26 what is the estimated cost for a 1000 gallon tank?

\$ _____

E. YOUR CONCERNS (USE BACK OF SHEET IF MORE SPACE IF REQUIRED).

28. Do you have any concerns in regard to tank installations or removals which need to be addressed?

F. ARE THERE ANY AREAS WHERE YOU FEEL MORE RESEARCH IS NECESSARY?

Yes: _____

No: _____

If yes, please list here:

Your Name: _____

Address: _____

Telephone No. _____

APPENDIX "B"

Incidents Resulting in Loss of Life

Maine Tank Removal Accident Prompts Words Of Precaution

Nationally, many tanks have been pulled out of the ground over the summer. In this process some accidents have occurred. It is extremely important that proper removal procedures be followed, especially for tanks containing volatile liquids or vapors. In response to a recent fatal tank removal accident in Portland, Maine, the State Department of Environmental Protection Bureau of Oil & Hazardous Materials Control issued the following memo, "Precautions During Tank Removal", to the State's Certified Underground Tank Installers . . . and other interested parties.

The accident in Portland was largely the result of using a vacuum truck to remove product from the tanks as well as moving air through the tanks to vent the tanks. Because there was no vapor removal mechanism anywhere on the vacuum truck, the air exhausted from the truck contained significant amounts of gasoline vapors. This problem was compounded by the location of the vacuum exhaust at a point low to the ground, and the enclosed nature of the site. These factors allowed the vapors, at the site, to accumulate to an explosive level. A spark from a vehicle ignited the gasoline vapors and fire traveled into a tank which

still contained an explosive level of gasoline vapors. The explosion in the tank blew out one end of the tank while the main body of the tank swung around and struck the victim of the explosion, killing him instantly. There is little doubt that vacuum trucks, as they are presently designed, are not suitable for pumping explosive liquids or vapors from storage tanks.

An issue which future regulations will address is whether any type of purging or venting operation to remove explosive vapors from a tank should be attempted on-site. Because any purging procedure will release some quantity of potentially explosive vapors into the surrounding area, public safety considerations may dictate that purging operations not be performed in densely populated areas where sources of ignition may be too numerous to control.

While the existing DEP regulations and American Petroleum Institute recommendations specify that the tank should be rendered gas-free prior to removal from the site, this should be done only if public safety concerns are completely addressed. In most cases, it will probably be safer to plug all tank openings, except for a 1/8" vent hole, and transport the tank

to a remote site where the venting operation can be done without endangering the public. When planning a gasoline tank removal, consult with the local fire chief - some communities have recently designated sites specifically for venting tanks.

Until a formal regulation change can be made, the following interim guidelines are suggested:

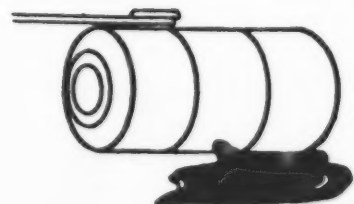
A. Vacuum trucks should not be used to pump explosive liquids or vapors unless the exhaust air from the vacuum pump is filtered or otherwise treated so that the exhaust air contains no explosive vapors. Explosion meters should always be used in conjunction with vacuum trucks to monitor the exhaust area.

Positive displacement pumps designed to be used where explosive conditions may exist (i.e. bronze gear pumps), are recommended for removing explosive liquids from storage.

B. Department of Environmental Protection regulations which specify the on-site gas-freeing of tanks should be disregarded if there is any possibility of this operation causing a threat to public safety. This operation should only be performed at remote sites where public access can be restricted.

C. All tanks should be transported from the site with all openings, including corrosion holes, plugged or capped except for a 1/8" vent hole. Tanks should be securely fastened to the transporting vehicle and be positioned such that the 1/8" vent hole is located on the uppermost point of the tank.

D. Tanks should only be cut up or dismantled in remote areas where public access can be restricted.■



Metal-cutter killed in gas tank explosion

By Bruce Street

Times-Colonist staff

A 25-year-old man cutting open a 22,750-litre gasoline tank with a torch was killed when the tank exploded Wednesday afternoon.

Parvinder Singh Thind had been working inside the house where he lived and worked at 6422 Pat Bay Hwy. in Central Saanich. The house is owned by J. B. Arnaud.

The man's body was found inside a crushed about 40 minutes after the explosion. The blast threw him 43 metres and through the building's

roof, said Central Saanich police Sgt. Don Mann.

The coroner pronounced him dead on the scene, provincial ambulance service spokesman Lynn Klein said. Coroner Chris Dumas is investigating.

"There must have been enough fumes left in the gasoline tank to cause the explosion," said Mann.

Mann said a business of buying old gas tanks and cutting them up for scrap is carried on from the property.

Fellow employees heard the explosion. However, when they didn't find

the young man, they assumed he was at lunch, said Mann.

A woman answering the phone at the address Wednesday night confirmed the initial belief of co-workers that no one had been injured.

Nearby resident Ian Adair, 3408 Costa Vista Pl., said he was in his garage when he heard the blast about 12:10 p.m.

"I just had the garage door open and boom! The place shook. I was standing on the concrete floor of my garage and I felt it through me. My wife said she could feel it inside the

house and a couple of ornaments fell off the wall. It shook the windows," he said.

Adair and several neighbors walked to the end of their cul-de-sac, where "we saw a ground-hugging smoke. It cleared quite quickly and there was the definite smell of propane."

As the neighbors and a couple of construction workers headed for the farm house and shed, someone Adair said he believed to be the owner warned them it was private property and to keep off.

The word spread in the group that no one had been hurt.

The Central Saanich dispatcher said the fire department was called at 12:14 p.m. Firemen were dispatched but had trouble locating the scene with the directions the caller had given.

Police and firemen arrived on the property after another neighbor called in with more detailed directions.

Police called an ambulance at 12:52 p.m., moments after the body was discovered.

APPENDIX "C"

Blank Questionnaire to Scrap Dealers

January 3, 1989

Dear Sirs:

Our department is currently involved in a project in conjunction with Environment Canada to identify methods for disposal of steel underground petroleum storage tanks removed from the sub-surface. The practice of selling these tanks for scrap is common in most provinces, we are attempting to contact scrap dealers in each province in order to obtain information on prices paid and in what condition dealers will accept these tanks.

It would be of great assistance to our project if your company could answer the attached questions.

We thank you in advance for your cooperation.

Yours truly,

DEBBIE JOHNSTON
Water Resources Branch

ACCEPTING UNDERGROUND PETROLEUM STORAGE TANKS FOR SCRAP

1. Do you accept underground petroleum storage tanks for scrap?
2. Do tanks have to be purged before your company will accept them?
3. Do you accept tanks containing sludge?
4. Do tanks have to have the ends cut out before they are purchased?
5. Do you accept tanks which have held leaded gasoline?
6. What method is used by your company to cut tanks (i.e. shears, torches)?
7. If tanks needs to be cut by your company what price is paid per ton? (Approximate only.)
8. If tanks are cut when delivered to your site, what price per ton is paid?
9. Please use this space for additional comments or information.

APPENDIX "D"
Suggested Practices as Issued by the
Institute of Scrap Iron & Steel to Scrap Dealers

Suggested Practices

1. Know the source. Do not accept storage tanks for processing unless the contents of the tank, at any time prior to its arrival at the scrap processing facility, are known, along with the identity of the tank owner or operator and/or the site location. Absent this knowledge, the acceptance of the tank could pose an unacceptable risk.

2. Require the supplier to certify that the tank has been purged (if the tank contained flammable materials), and completely cleaned. Only three methods are acceptable for purging a tank (based on National Fire Protection Association Guidelines, and American Petroleum Institute Procedures). These are:

- Fill with water and drain.
- Fill with inert gas, such as nitrogen or carbon dioxide. Alternatively, add dry ice (1.5 pounds per 100 gallons of tank capacity).
- Ventilate using compressed air and a gas exhauster, or equivalent means.

(Note: detailed procedures for purging tanks are included in Recommended Practice 1604, published by the American Petroleum Institute. Excerpts from this publication are available on request from ISIS/NARI.)

Appropriate cleaning methods are dependent on the material previously stored in the tank. More rigorous cleaning requirements may be necessary for some materials than others. If the material was highly soluble, a single rinsing may be sufficient. If the material left a sludge or insoluble residue in the tank, steam cleaning or other methods may be necessary.

In all cases, the scrap processor should require the vendor to provide certification and indemnification that the tank contains no "hazardous substances." (Suggested language for the certification/indemnification instrument is available from ISIS/NARI.)

3. After the vendor has purged and cleaned the tank, it should be cut, punctured, or otherwise opened to permit inspection. Preferably, the vendor should cut the tank into quarters, or remove the ends, prior to transporting the tank to the scrap processing facility.

4. No tank should be accepted by a processor unless verification of cleanliness is possible. Accept no tank if liquid or other residue remains inside. Tanks should be inspected to determine whether any sludge, scale, coating, or other extraneous material remains inside or adhering to the metal.

5. If a processor elects to accept a tank which has not been previously cut open by the vendor, the interior of the tank should be tested using a combustible gas indicator before any work is performed on the tank. (A list of manufacturers of such instruments is available on request from ISIS/NARI. Employees using these instruments must be fully trained, in accordance with the manufacturer's recommendations.)

6. Personnel processing tanks by use of torches should be provided and required to use appropriate protective equipment, to include respirators. Supplied air respirators may be necessary for torch cutting work performed inside a tank.

APPENDIX "E"

Scrap Dealers as Identified by
Contractors in Questionnaire

SCRAP DEALERS AS IDENTIFIED BY CONTRACTORS

IN QUESTIONNAIRE

NOVA SCOTIA

Maritime Oil Services
Dartmouth,
N.S.

Marine & Environmental Services
71 Ilesley Ave
Dartmouth, N.S.

East Side Auto Salvage
Lengan Rd.
Sydney, N.S.

Scrap Universal Metals
Sydney Industrial Park
Sydney, N.S.

Archie's Welding
Jones Rd.
New Minas,
N.S.

Redden Bros. Petroleum Ltd.
RR #1 Upper Raudon
Hants Co., N.S.

P.E.I.

MacDonald's Recycling
Sherwood
P.E.I.

NEW BRUNSWICK

Robert Hache Ltd.
P.O. Box 168
St. Isidore, N.B.

Lavines Scrap Metal
Rothesay Ave.
St. John, N.B.

Gunters Ltd.
Rockwood Ave.
Fred., N.B.

Cyclomat Ltd.
Scoudouc
N.B.

Sunnybrae Cleaners
Calodonia Ind. Park
Calodonia Rd., Moncton
N.B.

Ed's Welding & Const.
Riverside
N.B.

QUEBEC

Equipment Germain
305 Blvd. Homeau

Maurice Gemme
St. Amable
Quebec

MANITOBA

Monarch Metal Co.
8 Sutherland Ave.
Winnipeg, Man.

SASKATCHEWAN

Westell Rosco
540 10th Ave. E.
Regina, Sask.

ALBERTA

Nalcan Oilfield
Grand Prairie
Alberta

Harpers Metal
Red Deer
Alberta

W.E. Graham & Associates
New Sarepta
Alberta

B.C.

Regal Tank
Vancouver
B.C.

Dice Petroleum
523-114 Ave.
Dawson Creek, B.C.

D. Tidy Welders
Langley, B.C.

Pier Mac Steel Fabricator
770 Finns Road
Kelowna, B.C.

Davison Steel
Davison Creek, B.C.

ONTARIO

North 7 Iron & Metal
Toronto
Ontario

Newcastle Salvage
Newcastle
Ontario

Bakermat
2555 Sheifield Rd.
Ottawa, Ont.

John Zubick Scrap Metal
105 Clark Side Rd.
London, Ont.

Lakehead Scrap Metals
Thunder Bay
Ont.

The Right Company
Petroba, Ont.

K. R. Thompson Ltd.
Southview Dr.
Sudbury, Ont.

Fidelity Maintenance Ltd.
P.O. Box 267
Port Hope, Ont.